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(54) IMPROVEMENTS IN VEHICLE SEATS

(71) We, SOCIETE INDUSTRIELLE BERTRAND FAURE, a Societe Anonyme organised under the laws of France, of Brieres-les-Scelles, 91150 Etampes, France, do hereby declare invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to vehicle seats provided with a suspension device: the invention concerns more particularly the seats of heavy vehicles, such as lorries, motor coaches or tractors.

Such seats generally comprise two rigid frames arranged horizontally (or substantially horizontally), viz. a lower frame integral with the vehicle floor and an upper frame carrying the seating part of the seat; a connecting and guiding mechanism connects these two frames together for permitting their relative vertical movement, and a suspension device is interposed between these two frames for controlling resiliently and adjustably the said movement which will occur when such a seat is used in a moving vehicle and which is caused by the weight of the occupant of the seat and the vertical forces set up by the travelling of the vehicle.

In previous embodiments of such suspension devices it has been usual to provide the said device with at least one suspension spring whose action, generally a tension action, may be regulated by various means. However, the provision of these means often involved the presence of numerous joints, expensive to manufacture, and resulted in a relatively bulky suspension device; in addition, the actuation of these means often necessitated the use of sufficient force to overcome the tension of the suspension spring.

The present invention proposes a suspension device which has a small number of joints and a small bulk, and the adjustment of which can be effected by a small force.

The present invention provides a seat support comprising a rigid lower frame fixable to a floor and a rigid upper frame for carrying the seating member of a seat, a linkage and guiding mechanism connecting together the said two frames for permitting variations in their distance apart and a suspension device for controlling the said variations resiliently and adjustably, the suspension device incorporating at least one lever which is pivoted to one of the two frames and bears against a bearing portion carried by the other frame, at least one suspension spring urging the lever in a direction so as to move the two frames apart, and control means operable to move the bearing portion against which the lever bears controllably relative to the frame which carries it so as to alter the equilibrium length of the lever arm and hence the resilience of the suspension device.

In one embodiment of the invention, the suspension device has a single lever, and at least one suspension spring connecting the said single lever to one of the two frames.

In another embodiment of the invention, the suspension device has two levers each pivoted to one of the two frames and bearing against a respective bearing portion carried by the other frame, and at least one suspension spring connecting together the said two levers, the control means being operable to move each bearing portion controllably relative to the frame that carries it.

The invention allows adjustment of the suspension without acting directly on the suspension spring, and therefore without resorting to caps, stirrups or supports and hence with few joints; the small number of mechnical elements also makes it possible to provide a less bulky suspension device. Furthermore, the actuation of the control means requires little effort since one has to overcome principally merely the forces of friction, sliding or rolling, the control means affecting only slightly, or not at all, the tension of the suspension spring.

Also of importance is the simplicity of the mounting of the suspension spring, which can simply be hooked between the single

lever and a frame or between opposed ends of the two levers.

According to one advantageous arrangement of the invention the or each bearing portion comprises a roller whose axis is displaceable under the action of the control means, the or each roller bearing against a rolling track carried by the corresponding lever.

In the one (first-mentioned) embodiment of the invention, the roller is carried on the corresponding frame by the control means.

In the said one embodiment it is preferred that the single lever is pivoted to the upper frame and bears against a bearing portion carried by the lower frame. Preferably the single lever is a bell-crank lever and is pivoted at its crank to the upper frame, a suspension spring being interposed between the upper arm of the lever and the upper frame while a portion of the lower arm of the lever, situated towards the end of the lower arms, forms the rolling track on which bears the roller carried by the control means.

In the latter case the control means preferably comprises a movable strap which carries the roller, and a further support member on which the rollers rests. The further support member is advantageously formed by a ramp carried by the lower frame, the said ramp preferably being parallel or substantially so to the lower arm of the lever; according to this arrangement, it is possible to vary the position of the roller axis without displacing the lower arm of the lever.

Preferably the single lever is so adapted that the moment set up by the suspension spring around the pivoting axis of the lever increases when the spacing between the frames diminishes. To achieve this in the case of the bell-crank lever it is advantageous to arrange the lever such that its upper arm describes an arc of a circle situated, with respect to a vertical line passing through the pivoting axis, on the same side of this line as the spring.

To realise this condition, for spacings between upper and lower frames varying in use by a factor of a little over two (seat unoccupied, spacing 180 mm; seat occupied to the maximum weight, spacing 80 mm), the lower arm of the lever may suitably have an inclination varying from 30° above the horizontal to 20° above the horizontal, the upper arm of the said lever making an angle of about 80° with the lower arm.

In the other, second-mentioned embodiment of the invention, each roller is carried by one end of a link whose other end is connected to the lower frame, each said roller being supported on a rolling track integral with its lever, the control means being adapted to act on the links for producing their relative approach or movement apart. Preferably each lever is a bell-crank lever and is mounted for pivoting on a horizontal pin situated at its crank and connected to the upper frame, the said levers being arranged symmetrically, the upper arms of the said levers being connected together by the suspension spring, and the lower arm of each lever forming the rolling track with which the corresponding roller co-operates; the two links may have their lower ends connected to the lower frame by means of fixed pivots.

A preferred feature which may be used with supports according to the invention, and which is particularly applicable to cases in which the suspension device is arranged externally and laterally of the frames, is the provision of at least one compensation spring between the linkage and guiding mechanism and one of the two frames (preferably the upper frame), the said compensation spring being adjacent a lateral side of the support opposite the suspension device and acting so as to reinforce the bias of the suspension spring of the said suspension device. This arrangement of the compensation spring reduces any tendency to tilt, permitting a better distribution of the loads at the pivots of the linkage and guiding mechanism.

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is an elevation view showing the linkage and guiding mechanism of a first embodiment of a seat support according to the invention;

Fig. 2 is an elevation view showing the resilient and adjustable suspension device of this first embodiment;

Fig. 3 is a side elevation view showing the linkage and guiding mechanism of a second embodiment of the invention and a compensation spring which can be used therewith;

Fig. 4 is an elevation view showing the resilient and adjustable suspension device of this second embodiment;

Fig. 5 is a view illustrating a modification of the device shown in Fig. 4, and

Fig. 6 is a perspective view illustrating diagrammatically a detail of the device of Fig. 5.

Figs. 1 and 2 relate to a first embodiment of the invention in which the suspension device has a single lever.

As shown in these Figs. 1 and 2, the seat support comprises two rigid frames 1 and 2 arranged horizontally (or substantially horizontally), viz. a lower one 1 fixed to the floor of the vehicle (not shown), and an upper one 2, carrying the seat (shown in chain lines in Fig. 1); a linkage and guiding mechanism 4 connects these two frames 1 and 2 together to permit variations in their vertical spacing, and a suspension device 15 is interposed between these two frames 1 and 2 for con-

trolling resiliently and adjustably the said variations which are caused by the weight of the occupant of the seat and the forces set up by the travelling of the vehicle.

This linkage and guiding mechanism 4 may be formed as shown in Fig. 1, by two collapsible cross-pieces, arranged on either side of the longitudinal plane of the seat, only one of these collapsible cross-pieces 5 being visible in Fig. 1. Each cross-piece 5 comprises two diagonal bars 6 and 7 connected together respectively by pivots 9 and 10 fixed to the lower frame 1 and to the upper frame 2, whereas the two rear ends of these diagonal bars are connected respectively by sliding pivots 11 and 12 to the lower frame 1 and to the upper frame 2, the said frames having appropriate slides 13 and 14 for receiving the said sliding pivots 11 and 12.

The suspension device, denoted generally by the reference numeral 15, is interposed between the lower frame 1 and upper frame 2 for controlling resiliently and adjustably the variations of their vertical spacing which variations as already mentioned are a function of the weight of the occupant of the seat; this parameter may vary by a factor of two for vehicles which have to be driven by different drivers, and it is important that when the driver commences his duties he should be able rapidly to adjust the seat to adapt it to his weight. In the embodiment of Figs. 1 and 2 the resilient and adjustable suspension 15, interposed between the upper frame 2 and lower frame 1, is formed by a single lever 50 co-operating by means of a first joint with the upper frame 2 and bearing against a bearing portion 70 of the lower frame 1; this single lever 50 is connected to the upper frame 2 by at least one suspension spring 18.

The bearing portion 70 comprises a roller 52 which bears against a rolling track 51, the rolling track being carried by the lever 50 and the roller being carried by the lower frame 1, control means 19 producing the displacement of the axis of the said roller 52.

The single lever 50 may be in the form of a bell-crank lever, pivoted to the upper frame 2 by means of a pivot 53, the suspension spring 18 being interposed between the upper arm 50*a* of the said lever 50 and the upper frame 2, while the lower portion of the lower arm 50*b* of the said bent lever 50 bears against the roller 52. A length of the lower arm 50*b* of the lever 50 is then adapted to form the rolling track 51 against which bears the roller 52, the control means 19 permitting the displacement of the axis of the roller.

This control means is formed by a movable strap 54 carrying the roller 52 and by supporting means of the said roller or of its axle 55, which means advantageously comprises a ramp 56 carried by the lower frame and parallel to the lower arm 50*b* of the lever 50; with this arrangement, it is possible to vary the position of the axle 55 of the roller 52 without displacing the lower arm 50*b* of the lever 50, that is to say, without acting on the suspension spring 18, so that it is possible on the one hand not to modify the tension of the said suspension spring 18, and on the other hand to minimise the effort necessary for displacing the axle 55 of the roller 52—which effort has solely to overcome the frictional forces.

In order that the moment produced by the suspension spring 18 around the pivoting axis 53 of the lever 50 should increase when the distance between the upper frame 2 and lower frame 1 diminishes (that is to say, when the suspension device is in action), it is advantageous to arrange the lever 50 in such a manner that its upper arm 50*a* describes a circular arc C situated, with respect to the vertical line passing through the pivot axis 53, on the same side of the line as the suspension spring 18.

In Fig. 2, by way of example, the lower arm 50*b* of the lever 50 has an inclination varying from 30° above the horizontal passing through the support zone (suspension relaxed, frames separated by 180 mm) to 20° above the horizontal (suspension flattened, frames spaced apart by 80 mm) and the upper arm 50*a* of the lever 50 makes an angle of about 80° with the lower arm 50*b*.

When the suspension is flattened, the end A of the upper arm 50*a* comes to A^1 and during the stroke A—A^1, the variation of the lever arm is effected increasingly. Any impression of "softening" towards maximum flattening of the suspension is thus avoided.

The movable strap 54 is actuated by a screwthreaded rod 57, fixed axially by two stops 58 and 59 and co-operating with a screwthreaded nut 60 by means of a pivot 61.

A rotating knob 62, keyed to the end of the screwthreaded rod 57, enables the user to turn this screwthreaded rod 57 for displacing the roller 52 to adjust the suspension device.

Such a control means 19 may be completed by a pointer 63 moving over a graduated scale 64 on which may be marked the indications of the load which the seat can support.

Although the positioning of the suspension device 15 is not critical, it is advantageous to mount it, as shown in Fig. 2, between the two collapsible cross-pieces 5 of the linkage and guiding mechanism 4. This assembly is made possible by the small bulk of the suspension device 15. Under these conditions, the pivot axis 53 of the lever 50 on the upper frame 2 is parallel to the axes 9, 10, 11 and

12 of the linkage and guiding mechanism 4.

The control means 19 extends towards the front and its rotating knob 62 is very accessible to the user.

The scale 64 may be situated on the side of the seat visible when the user climbs into the vehicle, which shows him at once whether he has to make an adjustment of the suspension device in one direction or the other.

Finally, it should be mentioned that in addition it is possible to provide a shock absorber (not shown) betwen the collapsible cross-pieces 5 of the linkage and guiding mechanism 4, such mounting being rendered possible by the small bulk of the suspension device 15.

Figures 3 to 6 concern a second type of embodiment of the invention, in which the suspension device has a pair of levers.

Fig. 3 shows a seat suspension having two horizontally arranged rigid frames 1 and 2, i.e. a lower frame 1 fixed to the floor of the vehicle by means of a support 3, and an upper frame 2 carrying the seating part of the seat (not shown). The support 3 may have adjustment systems, for example a system for adjusting the longitudinal position of the seat and a system for adjusting the height of the seat.

A linkage and guiding mechanism, denoted generally by the reference numeral 4, connects the two frames 1 and 2 together for permitting variations in their vertical spacing.

This linkage and guiding mechanism 4 is constituted by two collapsible cross-pieces 5, arranged laterally on either side of the longitudinal plane of the seat, Fig. 3 showing only one of these collapsible cross-pieces 5. Each cross-piece 5 comprises two diagonal bars 6 and 7 connected together at their centre (approximately) by a pivot 8, the two front ends of these diagonal bars being connected by fixed pivots 9 and 10 to to the lower frame 1 and to the upper frame 2, whereas the two rear ends of these diagonal bars are connected respectively by two sliding pivots 11 and 12 to the lower frame 1 and to the upper frame 2, the said frames having appropriate slides 13 and 14 for receiving the said sliding pivots 11 and 12.

The suspension device, denoted generally by the reference numeral 15, controls resiliently and adjustably the variations in the vertical spacing between the lower and upper frames.

This suspension device may be arranged transversely at the rear of the two lower and upper frames 1 and 2, as shown in Fig. 3. It is formed essentially, as shown in Figs. 4 and 5 (in which the same reference numerals denote the same members as in Fig. 3) by a pair of levers 16 and 17 which co-operate by pivotal joints with the upper frame 2 and by supporting rollers 22 with the lower frame 1, and which are connected together by a suspension spring 18.

The supporting roller 22 of each lever 16 and 17 is movable by the action of control means for varying the equilibrium length of the lever arm and consequently for controlling the suspension device, the said control means being denoted in a general manner by the reference numeral 19.

Advantageously the rollers 22 connected to the lower frame 1 and constituting the bearing portions 20, 21 are displaceable by the action of the control means 19, the said rollers 22 bearing against rolling tracks 24 integral with the levers 16 and 17 which are pivoted at 25 and 26 respectively to the upper frame 2. The control means 19 is then adapted to act on the two links 23 for their relative movement towards or away from each other.

As shown clearly in Figures 4 and 5, the two levers 16 and 17 are advantageously bell-crank levers pivotally mounted on respective horizontal pivots 25 and 26 connected to the upper frame 2 of the device. These two levers 16 and 17 are arranged symmetrically with respect to the longitudinal plane of the seat. The two upper arms 16*a* and 17*a* are connected together by the suspension spring 18 and have two hooking lugs 16*c* and 17*c*, to which the two ends of the suspension spring are simply attached. The two lower arms 16*b* and 17*b* form the rolling tracks 24 with which the rollers 22 co-operate.

According to the construction shown in Fig. 4, the two links 23 have their lower ends connected firmly, by means of fixed pivots 27, to the lower frame 1.

The control means 19 may then have a transverse shaft 28 extending over the entire width of the seat and prevented from moving axially; each of the two links 23, this transverse shaft is screwthreaded and co-operates with a nut 29 carried by the link 23 and adapted to slide along the latter, guided by a slot 30, the two screwthreads being of opposite pitch. An operating member 31 is carried by one end of the transverse shaft 28 for operation by the user of the seat.

Each rollers 22 describes an arc of a circle. During the movement towards or away from each other of the two links 23, there is therefore produced at the same time as the desired increase or reduction in the length L of the arm of the levers 16 and 17, a slight modification of the tension of the suspension spring 18. For the two extreme positions of the links 23, the tension of the suspension spring 18 is a little weaker than for the middle position of the said links. However, this variation in tension of the suspension spring 18 has relatively little influence on the effort required for actuating the control

means 19, the said effort being limited substantially to the forces of friction, sliding and rolling of the members in relative movement during the period of this actuation.

According to the modification shown in Fig. 5, the two links 23 have their lower ends connected non-rigidly by means of sliding pivots 32 to the lower frame 1. For this purpose, the lower frame 1 may carry two plates 33, of which only one is visible in Figure 5, each plate 33 having two horizontally oriented slots 34 to permit sliding of the respective pivots 32 of the two links 23.

Each plate 33 has in addition two other slots 35 oriented obliquely and permitting guiding of the upper end of the two links 23, which are therefore connected to the plates 33 by another sliding pivot 36. These two slots 35 are inclined symmetrically with respect to the longitudinal plane of the seat.

As illustrated diagrammatically in Fig. 6, the control means 19 may then be formed by two levers 37, each carrying at its end a finger 38 engaged with clearance in a bore 39, provided in the respective sliding pivot 32, the said two levers 37 being pivoted respectively to two vertical pivots 40 on the lower frame 1. The said two levers 37 may each have an extension 37*a* permitting their connection to one another by means of a linkage by slot 41 and pin 42. An operating member 43 carried by one of the levers 37 makes it possible to control their pivoting which is then effected, due to the linkage 41—42, symmetrically with respect to the longitudinal plane of the seat, this pivoting causing the relative movement of the two fingers 38 towards or away from each other, and therefore the relative movement of the two links 23 towards and away from one another.

This manipulating member 43 is preferably formed by a rod extending from back to front and having its end 43*a* adapted to co-operate with a notched plate 44 arranged transversely at the front of the seat and having each of its notches 45 corresponding to an adjustment of the seat for a given weight of the user. Such adjustment is therefore effected very easily and the user rapidly ascertains if the end 43*a* is well engaged in the notch 45 corresponding to his weight, or if on the contrary the said end 43*a* should be moved for inserting it in another notch.

The two rollers 22 can each move through 90° of arc. During the approach or movement apart of the two links 23, the tension of the suspension spring 18 is absolutely unaltered, there being produced solely the desired increase or diminution of the length L of the arm of the levers 16 and 17.

The effort required for actuating the control means 19 is therefore limited solely to the forces of friction, sliding and rolling of the members in relative movement during the period of this actuation.

Fig. 3 illustrates an additional preferred feature of the invention, this being a compensation spring 46 interposed between the linkage and guiding mechanism 4 and one of the two frames 1 or 2, the said compensation spring 46 being arranged adjacent the side of the frame 1 or 2 opposite to the side adjacent which the suspension device is mounted, the spring 46 acting so as to reinforce the bias of the suspension device 15.

In Fig. 3 there is provided an upper extension 47 of the diagonal rod 6 and the compensation spring 46 is interposed between this upper extension 47 and the upper frame 2.

With this arrangement, the tendency to tilt, due to the rear positioning of the suspension device 15, is compensated by the action of the compensation spring 46. There is thus obtained a better distribution of the loads at the pivots of the linkage and guiding mechanism 4 as well as at the pivots of the suspension device 15. The action on the control means 19 is thereby also rendered more gentle.

The seat support according to the invention can be extremely compact because its important constructional elements (linkage and guiding mechanism, suspension device with its adjusting means and optional shock absorber) can be placed between the lower and the upper frames, or immediately behind the said frames.

Furthermore, and this is a very important advantage, the suspension device has a stiffness which increases with the suspended weight, so that the resonance frequencies of the seat are substantially constant irrespective of the weight of the seated person. This resonance frequency constancy makes it possible to avoid the risks of interference with the suspension of the vehicle on which the seat is mounted because it is merely necessary to arrange that the resonance frequency of the suspension device is of a different order of magnitude from that of the vehicle suspension.

WHAT WE CLAIM IS:—

1. A seat support comprising a rigid lower frame fixable to a floor and a rigid upper frame for carrying the seating member of a seat, a linkage and guiding mechanism connecting together the said two frames for permitting variations in their distance apart, and a suspension device for controlling the said variations resiliently and adjustably, the suspension device incorporating at least one lever which is pivoted to one of the two frames and bears against a bearing portion carried by the other frame, at least one suspension spring urging the lever in a direction so as to move the two frames apart, and control means operable to move the bearing portion against which the lever bears con-

trollably relative to the frame which carries is so as to alter the equilibrium length of the lever arm and hence the resilience of the suspension device.

2. A support according to claim 1 wherein the suspension device has a single lever, and at least one suspension spring connecting the said single lever to one of the two frames.

3. A support according to claim 2 wherein the single lever is pivoted to the upper frame and bears against a bearing portion carried by the lower frame.

4. A support according to claim 2 or 3 wherein the said suspension spring connects the single lever and the frame on which the said single lever is pivoted.

5. A support according to claim 2 or 3 or 4 wherein the bearing portion comprises a roller whose axis is displaceable under the action of the control means, the roller bearing against a rolling track carried by the lever.

6. A support according to claim 5 wherein the roller is carried on the corresponding frame by the control means.

7. A support according to claim 6 wherein the single lever is a bell-crank lever and is pivoted at its crank to the upper frame, a suspension spring being interposed between the upper arm of the lever and the upper frame while a portion of the lower arm of the lever, situated towards the end of the lower arm, forms the rolling track on which bears the roller carried by the control means.

8. A support according to claim 7 wherein the control means comprises a movable strap which carries the roller, and a further support member on which the roller rests.

9. A support according to claim 8 wherein the further support member is formed by a ramp carried by the lower frame and parallel or substantially parallel to the lower arm of the lever.

10. A support according to any one of claims 2 to 9 wherein the single lever is so adapted that the moment set up by the suspension spring or springs around the pivoting axis of the lever increases when the spacing between the frames diminishes.

11. A support according to any one of claims 2 to 10 wherein the suspension device is mounted between the two frames.

12. A support according to claim 1 wherein the suspension device has two levers each pivoted to one of the two frames and bearing against a respective bearing portion carried by the other frame, and at least one suspension spring connecting together the said two levers, the central means being operable to move each bearing portion controllably relative to the frame that carries it.

13. A support according to claim 12 wherein each bearing portion comprises a roller whose axis is displaceable under the action of the control means, each roller bearing against a rolling track carried by the corresponding lever.

14. A support according to claim 13 in which each roller is carried by one end of a link whose other end is connected to the lower frame, each said roller being supported on a rolling track integral with its lever, the control means being adapted to act on the links for producing their relative approach or movement apart.

15. A support according to claim 14 wherein each lever is a bell-crank lever and is mounted for pivoting on a horizontal pin situated at its crank and connected to the upper frame, the upper arms of the said levers being connected together by the suspension spring, and the lower arm of each lever forming the rolling track with which the corresponding roller co-operates.

16. A support according to claim 15 wherein the links have their lower ends connected to the lower frame by means of fixed pivots.

17. A support according to claim 16 wherein the control means is formed by a transverse shaft prevented from moving axially, the transverse shaft having at each of the two links a screwthread co-operating with a female thread carried by the link, the two screwthreads being of opposite pitch.

18. A support according to claim 15 in which each link has its lower end connected to the lower frame by means of a sliding pin.

19. A support according to claim 18 in which the lower frame carries plates each having slots oriented for permitting the sliding of the said sliding pins, and other slots oriented for permitting the guiding of the upper ends of the links by means of further sliding pins.

20. A support according to claim 19 wherein the control means is formed by control levers each carrying at the end of the control lever a finger engaged with play in a bore provided in a respective sliding pin of the lower end of a respective link, the control levers being pivoted around respective vertical pins on the lower frame and being linked by means synchronising the angular displacements of the control levers.

21. A support according to claim 20 in which one of the control levers is integral with a rod permitting the control of the pivoting of the levers, the said rod having a front end which co-operates with a plate having slots spaced transversely of the support.

22. A support according to any one of claims 12 to 21 wherein the suspension device is disposed externally and laterally of the said frames, the support having a compensation spring interposed between the link-

age and guiding mechanism and one of the two frames, the said compensation spring being adjacent a lateral side of the support opposite the suspension device and acting so as to reinforce the bias of the suspension spring of the said suspension device.

23. A support according to claim 22 in which the compensation spring is interposed between the connecting and guiding mechanism and the upper frame.

24. A seat mounted on a support according to claim 1.

25. A seat mounted on a support according to any one of claims 2 to 11.

26. A seat mounted on a support according to any one of claims 12 to 23.

27. A vehicle seat according to claim 24.

28. A vehicle seat according to claim 25.

29. A vehicle seat according to claim 26.

30. A seat support substantially as hereinbefore described with reference to Figs. 1 and 2 of the accompanying drawings.

31. A seat support substantially as hereinbefore described with reference to Figs. 3 and 4 of the accompanying drawings.

32. A seat support substantially as hereinbefore described with reference to Figs. 5 and 6 of the accompanying drawings.

33. A supported seat substantially as hereinbefore described with reference to Figs. 1 and 2 of the accompanying drawings.

34. A supported seat substantially as hereinbefore described with reference to Figs. 3 and 4 of the accompanying drawings.

35. A supported seat substantially as hereinbefore described with reference to Figs. 5 and 6 of the accompanying drawings.

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Fig.1.

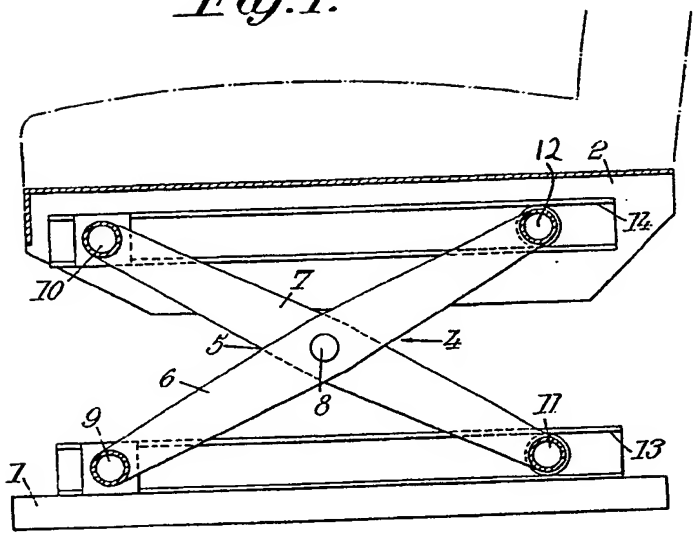
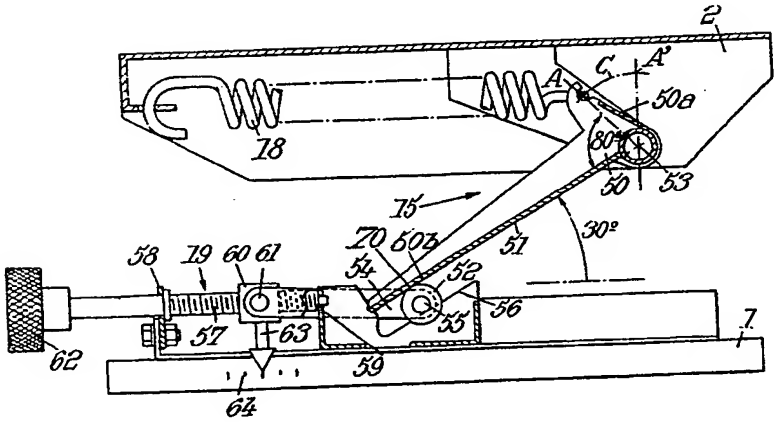


Fig.2.



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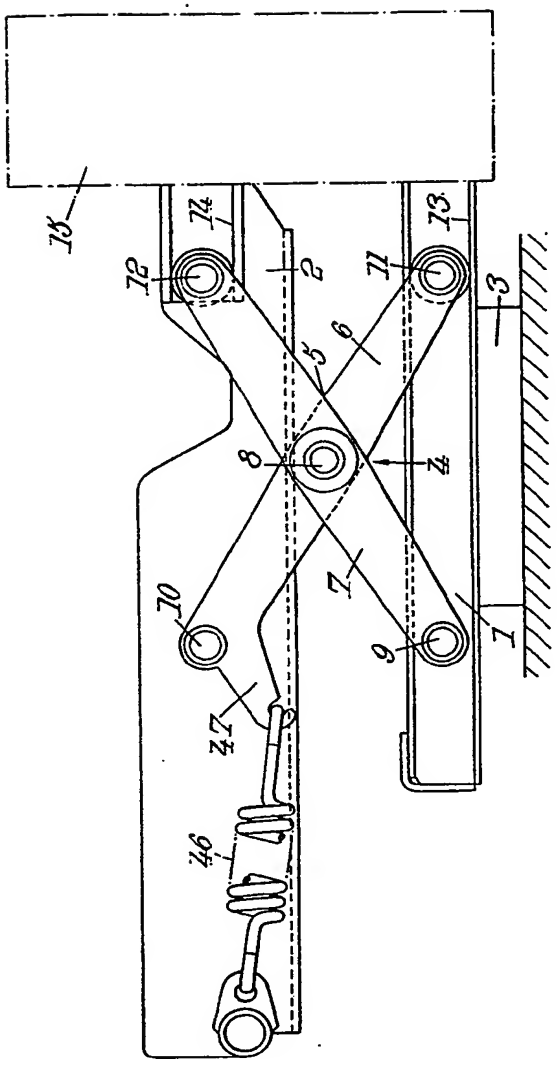

Fig. 3.

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Fig. 4.

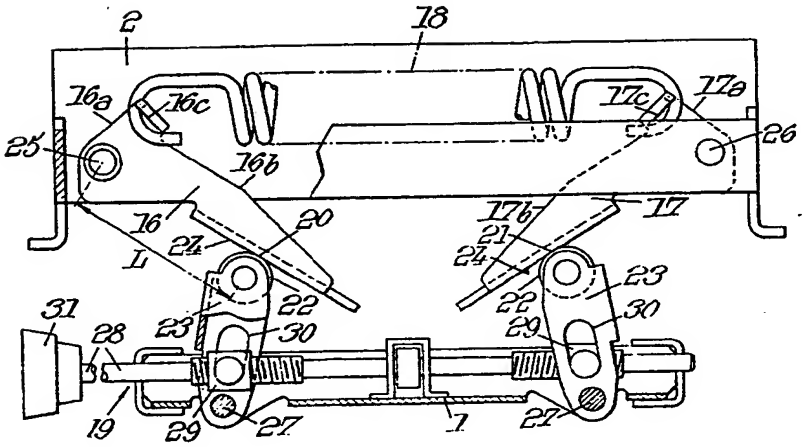
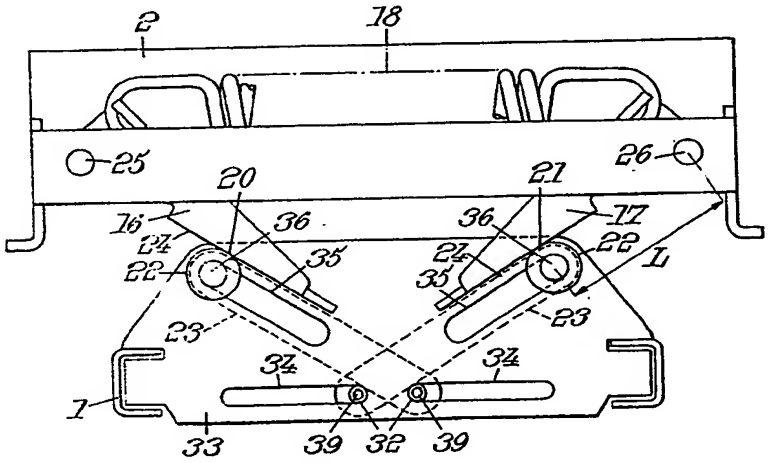


Fig. 5.



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Sheet 4

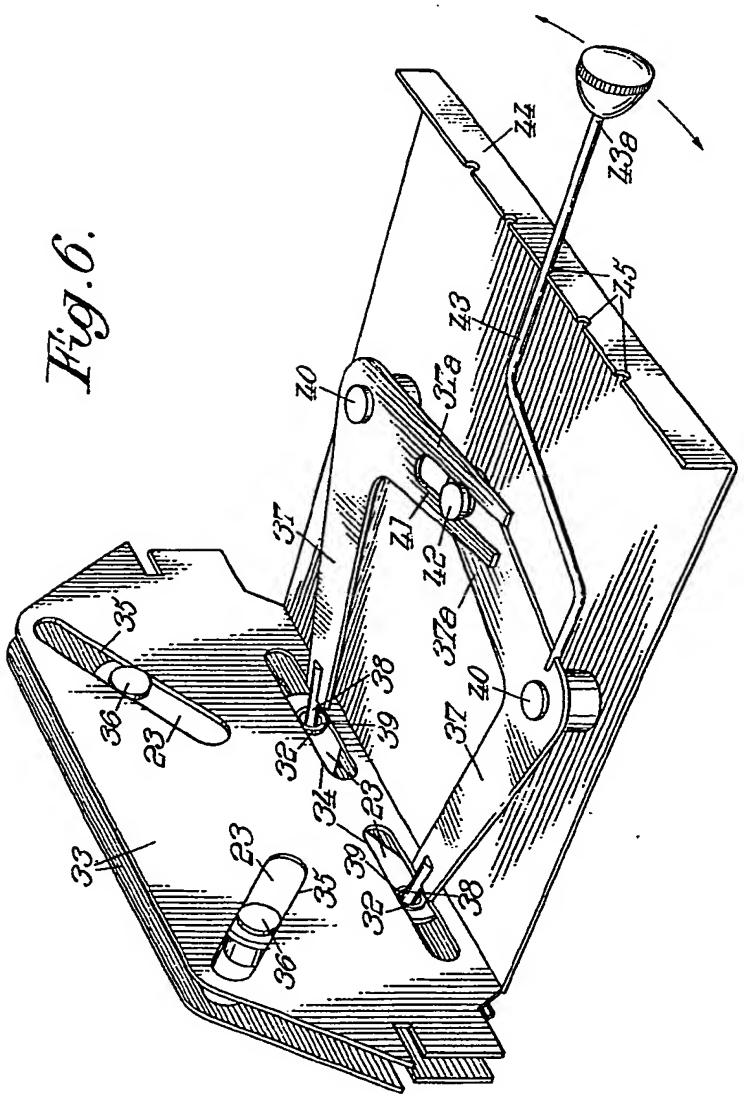

Fig. 6.